SonNet®

Manual
Wireless Sensing System

System User Manual
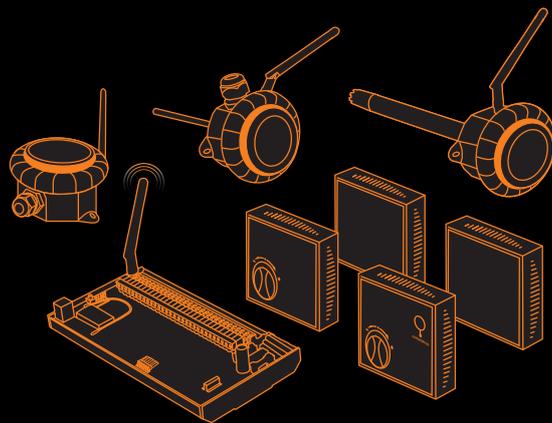
Sontay® SonNet Radio Sensor System

User Manual

Version 1.8

June 2011

Audience

This manual is intended for specifiers, users and installers of the Sontay® SonNet radio sensor system.

Content

This manual provides a complete reference for the Sontay® SonNet radio sensor system.

Related Documents

The Sontay® SonNet radio sensor system Site Survey Kit Quick Start Guide
The Sontay® SonNet radio sensor system Site Survey Kit Manual
The Sontay® SonNet radio sensor system Quick Start Guide
The Sontay® SonNet radio sensor system product datasheets

Table Of Contents:

Overview

The wireless nodes are based on direct-sequence spread spectrum communication in the 2.4 - 2.5GHz band, compliant with IEEE 802.15.4-2006.

All nodes have a unique MAC address, equivalent to a unique serial number.

All nodes have a PCB-mounted on/off switch or jumper.

All nodes retain their configuration properties across a power failure.

Environmental

- Storage temperature range of -10 to +80°C
- Storage relative humidity range of 0 to 90% (non-condensing).
- Ambient (operating) temperature range of -10°C to +70°C
- Ambient (operating) relative humidity range of 0 to 90%, (non-condensing).

Battery Fitting and Replacement

When a battery is installed, or when it is replaced, observing the correct polarity is very important. Fitting the battery incorrectly may result in permanent damage to the sensor.

Recommended batteries are 3.6Vdc 2.4Ah AA size Lithium-Thionyl Chloride types for space housing sensors, or 3.6Vdc 2.1Ah 2/3 A size Lithium-Thionyl Chloride types for plant housing sensors, and are **not rechargeable**.

This type of battery should be stored in a clean, cool (not exceeding +30°C), dry and ventilated area.

Disposal of Batteries - Warning! Fire, Explosion And Burn Hazard

Disposal of Batteries - Warning! Fire, Explosion and Burn Hazard.

Do not short-circuit, crush, disassemble, heat above 100°C (212°F), incinerate, or expose the battery contents to water. Do not solder directly to the cell.

All batteries must be disposed of in accordance with EC Directive 2006/66/EC, amended by EU Directive 2008/12/EC.

Battery Powered Nodes

Battery powered sensor nodes are used in conjunction with the Sontay® **RF-RX20** or **RF-RX40** receiver units, and if required (depending on installation topography), Sontay® **RF-RS** series of routers. Data is transmitted back to the receiver at configurable time intervals, or on a configurable change in measured value. Each sensor retains these configurations if the battery becomes discharged or requires replacement.

The sensors automatically find the best path back to the receiver, which may be directly to the receiver or *via* "parent" routers.

To power a battery powered node, jumper J400 must be fitted. To switch off, remove J400.

Battery powered nodes are available in 4 formats:

- Space mounting temperature, with setpoint and momentary switch options
- Space mounting RH&T, with setpoint and momentary switch options
- Plant mounting temperature
- Plant mounting RH&T

Space Mounting Specification:

Radio Output:
    Frequency   2.4GHz
    16 channels, automatically selected, direct-sequence spread spectrum
    Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
    Gain   1.2dBi
    VSWR   1.5:1
Data Encryption: AES 128
Power Output: 0dBm
Accuracy:
    Temperature   ±0.3°C
    Optional RH   ±3% RH
Battery Type: 3.6V AA 2.4Ah Li-SOCl$_2$, non-rechargeable
Battery Life: >3 years (depending on configuration)
Housing:
Material: ABS (flame retardant)
Dimensions: 85 x 85 x 23mm
Environmental:
Operating:
    Temperature: -10°C to +50°C
    RH: 0 to 90%, non-condensing
Storage:
    Temperature: -10°C to +80°C
    RH: 0 to 90%, non-condensing
Country of origin: UK

Refer to product datasheets for installation instructions.

Plant Mounting Specification:

Radio Output:
   Frequency 2.4GHz
   16 channels, automatically selected, direct-sequence spread spectrum
   Compliance IEEE 802.15.4-2006
Aerial Characteristics:
   Gain   2.0dBi
   VSWR   2:1
Data Encryption: AES 128
Power Output: 0dBm
Accuracy:
   Temperature ±0.3°C
   Optional RH ±3% RH
Battery Type: 3.6V 2.1Ah 2/3 A Li-SOCl$_2$, non-rechargeable
Battery Life: >3 years (depending on configuration)
Housing:
Material: ABS (flame retardant type VO)
Dimensions: 55mm x 90mm dia.
Mounting: Holes 4mm spaced 85mm apart
Protection: IP65
Environmental:
Operating:
   Temperature: -10°C to +50°C
   RH: 0 to 90%, non-condensing
Storage:
   Temperature: -10°C to +80°C
   RH: 0 to 90%, non-condensing
Country of origin: UK

Temperature Sensor Types:
   Duct
   Outside air
   Outside air with solar radiation shield
   Immersion
   Strap-on
   Flying lead

Refer to product datasheets for installation instructions.

Part Codes: Battery Powered Space Housing Nodes:

- **RF-RS-T-911** - Temperature sensor
- **RF-RS-T-911-SP** - Temperature sensor c/w setpoint knob
- **RF-RS-T-911-MS** - Temperature sensor c/w momentary switch
- **RF-RS-T-911-SP-MS** - Temperature sensor c/w setpoint knob & momentary switch
- **RF-RS-R-911** - RH&T sensor
- **RF-RS-R-911-SP** - RH&T sensor c/w setpoint knob
- **RF-RS-R-911-MS** - RH&T sensor c/w momentary switch
- **RF-RS-R-911-SP-MS** - RH&T sensor c/w setpoint knob & momentary switch

Part Codes: Battery Powered Plant Housing Nodes:

- **RF-RS-T-522** – Duct temperature sensor
- **RF-RS-T-531** – OAT temperature sensor
- **RF-RS-T-532** – OAT + radiation shield temperature sensor
- **RF-RS-T-541** – Immersion temperature sensor
- **RF-RS-T-551** – Strap-On temperature sensor
- **RF-RS-T-555** – Flying Lead temperature sensor
- **RF-RS-R-522** – Duct RH&T sensor

24V Powered Routers

24V powered routers are used in conjunction with the Sontay® **RF-RX20** or **RF-RX40** receiver units, and **RF-RR** series of battery powered radio sensors, and are used to route signals from battery powered nodes and other routers to the receiver module, where the signal strength of a direct path is not sufficient for reliable communications. **NB** Each router can support a maximum of 16 "children", which can consist of a maximum of 8 battery powered nodes and 8 routers, *or* up to 16 routers *if* there are no battery powered nodes. Consideration should be given on network planning for redundancy in case of router failure or damage.

Data is transmitted back to the receiver at configurable time intervals, or on a configurable change in measured value. Each sensor retains these configurations if the battery becomes discharged or requires replacement. Routers automatically find the best path back to the receiver, which may be directly to the receiver or *via* other "parent" routers.

To power a router, jumper J200 must be fitted. To switch off, remove J200.

24V powered nodes are available in 5 formats:

- Space mounting temperature, with setpoint and momentary switch options
- Space mounting RH&T, with setpoint and momentary switch options
- Plant mounting router, no sensor functions
- Plant mounting temperature
- Plant mounting RH&T

Space Mounting Specification:

Radio Output:
      Frequency   2.4GHz
      16 channels, automatically selected
      Direct-sequence spread spectrum
      Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
      Gain   1.2dBi
      VSWR   1.5:1
Data Encryption: AES 128
Power Output: +10dBm
Accuracy:
      Temperature   ±0.3°C
      Optional RH   ±3% RH
Power Supply: 24Vac/dc
Housing:
Material: ABS (flame retardant)
Dimensions: 85 x 85 x 23mm

Environmental:
Operating:
       Temperature: -10°C to +50°C
       RH: 0 to 90%, non-condensing
Storage:
       Temperature: -10°C to +80°C
       RH: 0 to 90%, non-condensing
Country of origin: UK

Refer to product datasheets for installation instructions.

Plant Mounting Specification:

Radio Output:
       Frequency   2.4GHz
       16 channels, automatically selected, direct-sequence spread spectrum
       Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
       Gain   2.0dBi
       VSWR   2:1
Data Encryption: AES 128
Power Output: +10dBm
Accuracy:
       Temperature   ±0.3°C
       Optional RH   ±3% RH
Power Supply: 24Vac/dc
Housing:
Material: ABS (flame retardant type VO)
Dimensions: 55mm x 90mm dia.
Mounting: Holes 4mm spaced 85mm apart
Protection: IP65
Environmental:
Operating:
       Temperature: -10°C to +50°C
       RH: 0 to 90%, non-condensing
Storage:
       Temperature: -10°C to +80°C
       RH: 0 to 90%, non-condensing
Country of origin: UK

Temperature Sensor Types:
       Duct
       Outside air
       Outside air with solar radiation shield
       Immersion
       Strap-on
       Flying lead

Refer to product datasheets for installation instructions.

Part Codes: 24V Powered Space Housing Routers:

- **RF-RR-T-911** – Router temperature sensor
- **RF-RR-T-911-SP** - Router temperature sensor c/w setpoint knob
- **RF-RR-T-911-MS** - Router temperature sensor c/w momentary switch
- **RF-RR-T-911-SP-MS** - Router temperature sensor c/w setpoint knob & momentary switch
- **RF-RR-R-911** - Router RH&T sensor
- **RF-RR-R-911-SP** - Router RH&T sensor c/w setpoint knob
- **RF-RR-R-911-MS** - Router RH&T sensor c/w momentary switch
- **RF-RR-R-911-SP-MS** - Router RH&T sensor c/w setpoint knob & momentary switch

Part Codes: 24V Powered Plant Housing Routers:

- **RF-RR** - Router
- **RF-RR-T-522** – Router duct temperature sensor
- **RF-RR-T-531** – Router OAT temperature sensor
- **RF-RR-T-532** – Router OAT + radiation shield temperature sensor
- **RF-RR-T-541** – Router immersion temperature sensor
- **RF-RR-T-551** – Router strap-On temperature sensor
- **RF-RR-T-555** – Router flying Lead temperature sensor
- **RF-RR-R-522** – Router duct RH&T sensor

The System Receiver

The Sontay® **RF-RX20** or **RF-RX40** receiver collects data from all other devices on the radio network, including measurements from sensors, link quality for all links formed in the network, battery levels for all battery powered devices, hours run for all devices and the current status of all devices. **NB** Each receiver can support a maximum of 16 "children", which can consist of a maximum of 12 battery powered nodes and 4 routers, *or* up to 16 routers *if* there are no battery powered nodes.

A USB socket is provided for connection to a PC or laptop running the Sontay SonNet CMS software.

Receivers are available in 2 formats:

- **RF-RX20** - 20 x 0-10Vdc analogue outputs
- **RF-RX40** - 40 x 0-10Vdc analogue outputs

If a 20 output receiver is installed, and further outputs are subsequently required, a separate "daughter" PCB (**RF-DB20**) with 20 extra outputs can be added, without having to replace the existing receiver.

Receiver Specification:

Radio Output:
        Frequency   2.4GHz
        16 channels, automatically selected
        Direct-sequence spread spectrum
        Compliance   IEEE 802.15.4-2006
Aerial Characteristics:
        Gain   2.0dBi
        VSWR   2:1
Data Encryption: AES 128
Power Output: +10dBm

Analogue Outputs:

    RF-RX20 20 x 0-10Vdc analogue outputs @10mA max. each

    RF-RX40 40 x 0-10Vdc analogue outputs @10mA max. each

Output ranges:

Temperature	-10°C to +70°C
RH	0% to +100%
Setpoint	0% to +100%
Switch	0Vdc = OFF, 10Vdc = ON

Power Supply: 24Vac/dc

Housing:

    DIN Rail   W203 x H104 x D38mm (excluding aerial)

Environmental:

Operating:

Temperature:	-10°C to +50°C
RH:	0 to 90%, non-condensing

Storage:

Temperature:	-10°C to +80°C
RH:	0 to 90%, non-condensing

Country of origin: UK

Refer to product datasheets for installation instructions.

Part Codes:

- **RF-RX20** - Receiver c/w 20 x 0-10Vdc outputs
- **RF-RX40** - Receiver c/w 40 x 0-10Vdc outputs
- **RF-DB20** - 20 x 0-10Vdc output expansion daughter board for **RF-RX20**
- **RF-AERIAL** – Replacement whip aerial
- **RF-AERIAL-2** – 2m coaxial cable extension
- **RF-AERIAL-5** – 5m coaxial cable extension

The Radio Network

A Sontay® SonNet radio system is comprised of a receiver, battery powered sensors and permanently powered routers.

Routers, though permanently powered, can also have sensing elements, accomplishing both router and sensors functions. Routers and sensors can either communicate directly with the receiver or *via* other routers. Routers are required to be permanently powered as they need to stay "awake" at all times to allow signals from "child" nodes to be instantly forwarded to their "parent" nodes. Battery powered sensors only "wake" for very short periods to send data.
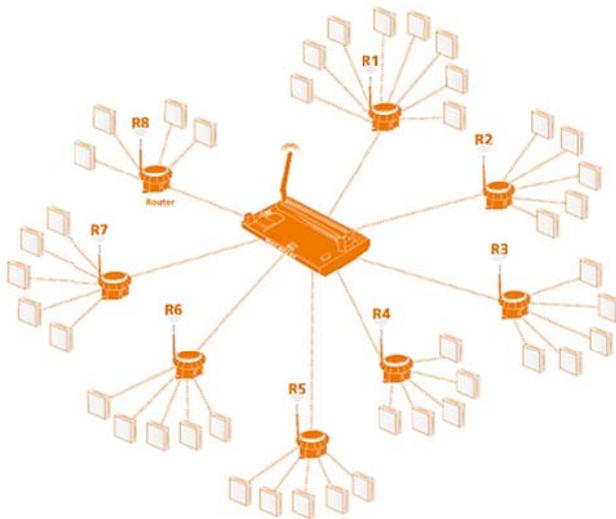
In the schematic above, routers **R2 to R7** have 5 children each, all battery powered sensors. Their parent is the receiver. Router **R1** has 6 children and **R8** has 4 children, giving a total number of network devices of 50, including the receiver.

The receiver can support a **maximum** of 16 directly connected "child" devices, of which only 12 can be battery powered nodes, plus up to 4 routers.

Routers can support a **maximum** of 16 directly connected "child" devices, of which only 8 can be battery powered nodes, plus up to 8 routers.
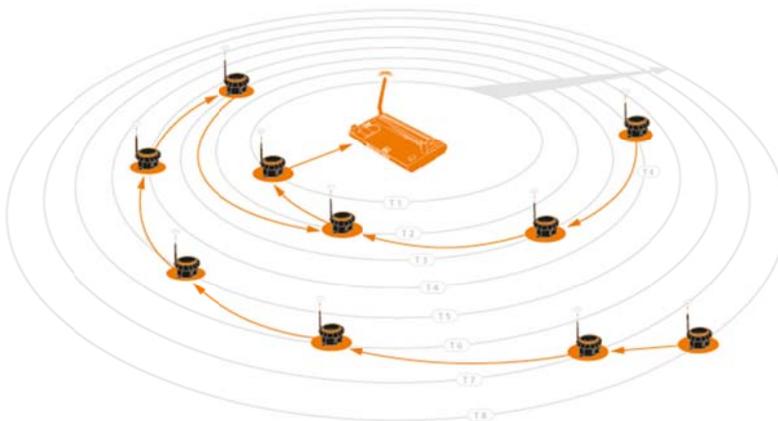
There can be a maximum depth of 8 layers of routers in a network and a maximum of 50 nodes per network with the **RF-RX** series of receivers.

Note that battery powered devices can only route their signals to the receiver directly or through routers, and **not through other battery powered devices**.

When planning a SonNet radio network, it is recommend that the Sontay® SonNet Site Survey Kit be used. This easy-to-use package allows installers to test signal strengths between locations required for battery powered sensors and the receiver prior to installing the full system. It can also identify whether routers are needed to ensure reliable communications between all devices on the network back to the receiver. This removes any guesswork from planning a system and allows the installer to order exactly and only the devices required.

See the Sontay® SonNet radio sensor system Site Survey Kit Quick Start Guide and The Sontay® SonNet radio sensor system Site Survey Kit Manual for full details.

Network Planning Considerations

When planning a SonNet radio system, it is always worth considering the placement of routers, and should be capable of handling the consequences of a router failing or being damaged.

Example:

Consider a network with a requirement for 16 EDs:
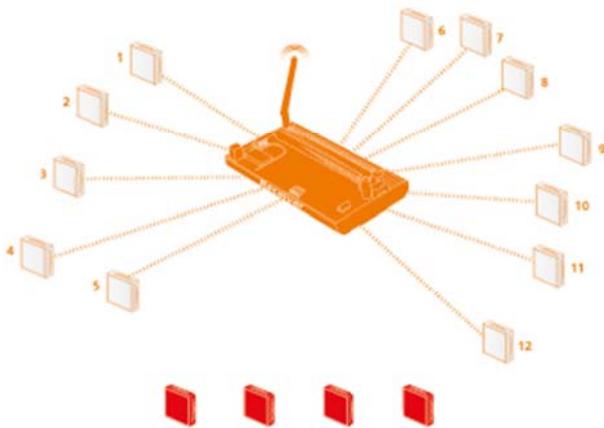
1. At least one router is required, as 16 directly connected EDs will exceed the maximum limit of 12. Four EDs will be orphaned.
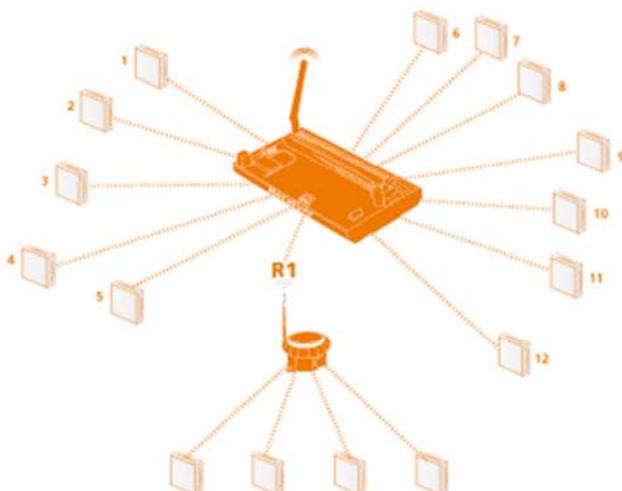
2. A single router (R1) will work, but gives no redundancy if the router should fail.
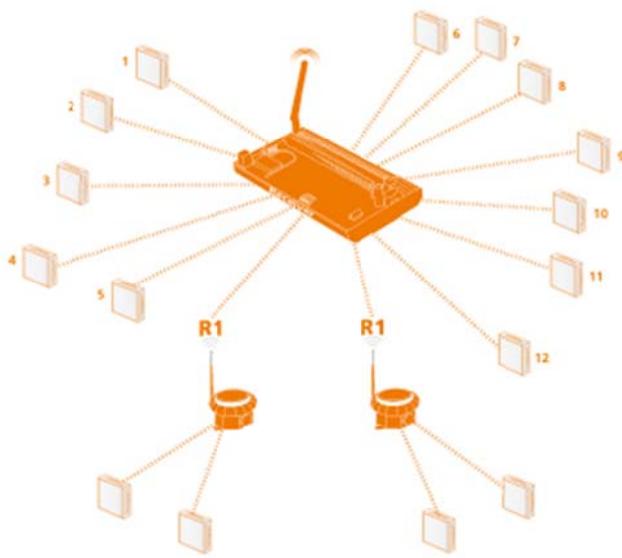
3. Optimal network uses 2 routers, R1 and R2.
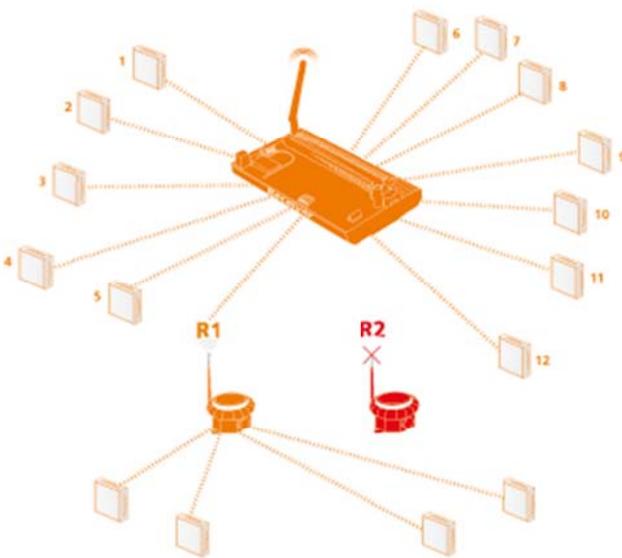
4. If either of the routers fail, the network can still be maintained, as the 2 orphaned EDs can re-route via the other router.

The Radio System

The radio system used by the Sontay SonNet devices is divided into 3 sections or 'layers'.

1.   The radio layer is where physical control of the radio signal is done. This conforms to international standard 802.15.4, and determines the frequency of the radio signals, the number of 'channels' available for use, the bandwidth and power level of the signal etc. There are 16 channels available, and the best one is automatically selected by the receiver. The frequencies used are in the ISM (Industrial, Scientific and Medical) 2.4GHz band, with a maximum data rate of 250kb/s.
2.   The network management layer is where the self-healing tree functionality is run, which controls network topology. 'ZigBee' is an example of a network management MESH protocol. SonNet does not use ZigBee, but instead uses a 'self-healing tree' protocol to control network topology.
3.   The application layer is what determines what the device does – i.e. makes it a temperature sensing device, a router or a receiver. SonNet devices use specific applications, and include features such as configuration properties.

Security

All SonNet system devices have the same, unique network identifier. Only devices with the correct ID will be allowed to join the network. The ID used by system devices is different from the ID used for site survey kit (SSK) devices. Hence, SSK devices cannot join a system network and vice versa. When a SonNet system network has been formed, it can be 'locked' to prevent any unauthorised devices joining, even if they are SonNet devices. The CMS can be used to authorise extra SonNet system devices if required.

All data transmitted by SonNet devices is encrypted.

How the Self-Healing Tree Network Is Formed

The network is formed based on 3 rules, and in a specific order of priority.

1.   *How many 'tiers' a device is away from the receiver.*

If a device can communicate directly with the receiver, it will, even if the link quality is poorer than if it went through a router. If a device has a choice of more than one router, it will *always* choose the router closest to the receiver (the least number of tiers away), *even if the link quality is poor*.

2.   *The number of 'child' devices a router already has.*

A router can have a maximum of 16 'children'. If a device has a choice of more than one router of the same tier level, it will *always* choose the router with the least number of children, *even if the link quality is poor*.

3.   *Signal Strength (link quality).*

Finally, if a device has a choice of more than one router of the same tier level and the same number of children, it will choose the router with the best link quality.
If, for any reason, a device (node or router), loses it's preferred path back to the receiver, it will automatically search for an alternative – still obeying the 3 rules above in sequence. If, despite employing Direct Sequence Spread Spectrum (DSSS) techniques, interference on the currently occupied channel prevents communications, the receiver will automatically look for another channel which is clear. All other devices, having lost their links to the receiver, will then also automatically scan the 16 channels until they find the receiver again, and the network will re-form without user intervention.

Propagation Of Radio Signals In Buildings

The propagation of microwave radio signals in a building can be affected in several ways:

Attenuation
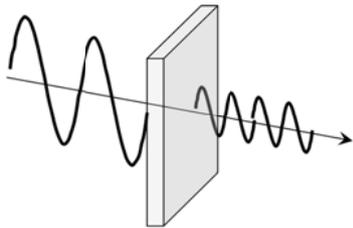
Radio signal strength is attenuated when it passes through air. Signals are attenuated much more when passing through other media, such as materials typically used in construction, such as brick, stone, wood and especially steel.

Reflection
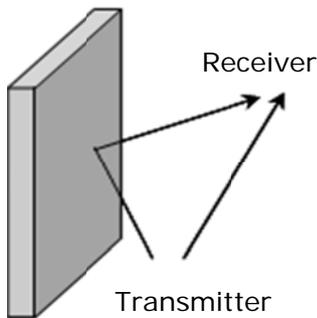
Depending on the building, radio signals can take many paths from the transmitter to the receiver, rather than just one single path.

'Multipath' signals can have the effect of cancelling each other out, reducing overall received signal strength.

Scattering
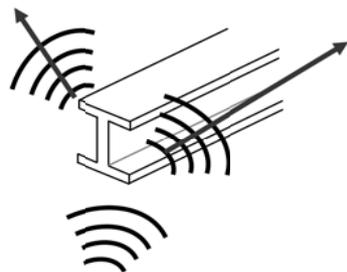
Scattering the radio signal can also reduce it's signal strength.

FAQs

a. *How is access to the sensor network locked at the CMS?*

Nodes are only allowed to join the network if the receiver allows them to. This is true even if the nodes are identified as SonNet Nodes and have the correct encryption key.

There are two methods to configuring the receiver to accept nodes on to the network. In order to authorise a node the CMS must be in administration mode (File->Switch Admin Mode must be ticked).

- Auto Commissioning Mode

The CMS allows the receiver to be switched to auto commissioning mode. In this mode any nodes that can correctly identify themselves as SonNet nodes will be allowed to join the network. Any nodes that do join will be added to the CMS textual display.

- Manual Mode

In manual mode individual nodes can be removed from or added to the authorised node list from the CMS. Manual mode is the default mode.

A node can then be authorised by Options->Authorise (add) a new node or selecting the same option on the right click menu in the Textual or Graphical parts of the application display.

The user must type the MAC address (found on the PCB or product housing) of the new node into the dialog that appears and can also give the node a textual name (up to 10 characters)

b. *Why do some menu items disappear if the CMS application is idle for some time?*

The CMS has a timeout that operates when in Admin mode. If there is no activity for some time the CMS application will exit admin mode and some admin menu items will be disabled or removed.

The timeout can be set in Options-> Change Idle Time.

Admin mode can be entered again in File->Switch Admin Mode

c. *The CMS application right click menu has stopped being provided. Why?*

This probably means that the CMS has detected that the receiver has been disconnected from the PC. This will be indicated on the status bar at the bottom left side of the CMS application window "Receiver Disconnected". In this state many of the CMS facilities are disabled until the Receiver is connected again.

d. *How are the network node names stored, are they persistent?*

The node names are stored in the receiver hardware in non-volatile memory. Therefore these will be the same even if a different PC is attached to the system, or the receiver is reset / power cycled.

e. *In the CMS application what is an Unknown node?*

The application will list all nodes that have been added to the system as unknown initially. As soon as a node is added (either manually or by the use of auto commissioning mode) a request is sent to it to establish what type of node it is and what capabilities it has.

As a result a node will be categorized as unknown until a response is received from it. If the node remains off-line or does not respond for any other reason it will remain in this category.

The CMS will send a request each time it is started if there are still unknown nodes in the system.

f. *What are the ranges of the receiver 0-10Vdc outputs?*

Temperature	-10°C to +70°C
RH	0% to +100%
Setpoint	0% to +100%
Switch	0Vdc = OFF (False), 10Vdc = ON (True)

Configuration & Monitoring Software (CMS)

The CMS is connected, *via* USB, to a Sontay® **RF-RX20** or **RF-RX40** receiver, and is used to configure:

- Receiver output channel mapping
- Sensor node parameters, including;
    - Default data transmission time
    - Send on value change settings
    - User-defined labels

It can also be used for;

- Enabling or disabling automatic configuration mode
- Adding or removing nodes
- Providing a text and graphical display of the network
- Monitor device status
- Monitor link and battery quality
- View logs for receiver configuration changes

The CMS installation procedure installs 3 components:

- Microsoft® SQL Server 2005 Express Edition SP2
- Sontay® SonNet CMS
- Sontay® device USB device drivers

NB It is important that the CMS installation be completed *prior* to connecting the PC to the receiver.

Important – Windows 7 Users

Prior to installing CMS, it is important to turn off driver signing.

From the Start menu, type cmd.exe in the search bar. Right click on cmd.exe and choose run as administrator.
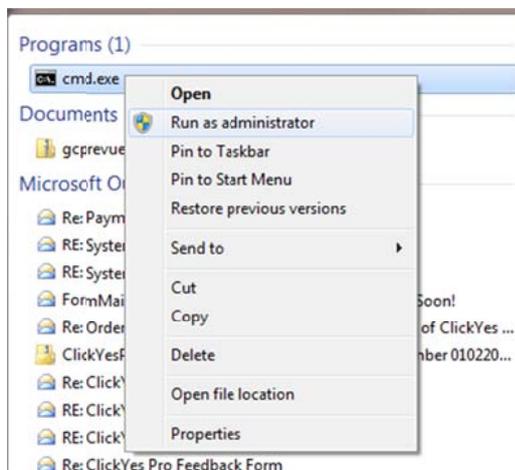
Run the following commands in the shell.

bcdedit.exe -set loadoptions DDISABLE_INTEGRITY_CHECKS
bcdedit.exe -set TESTSIGNING ON
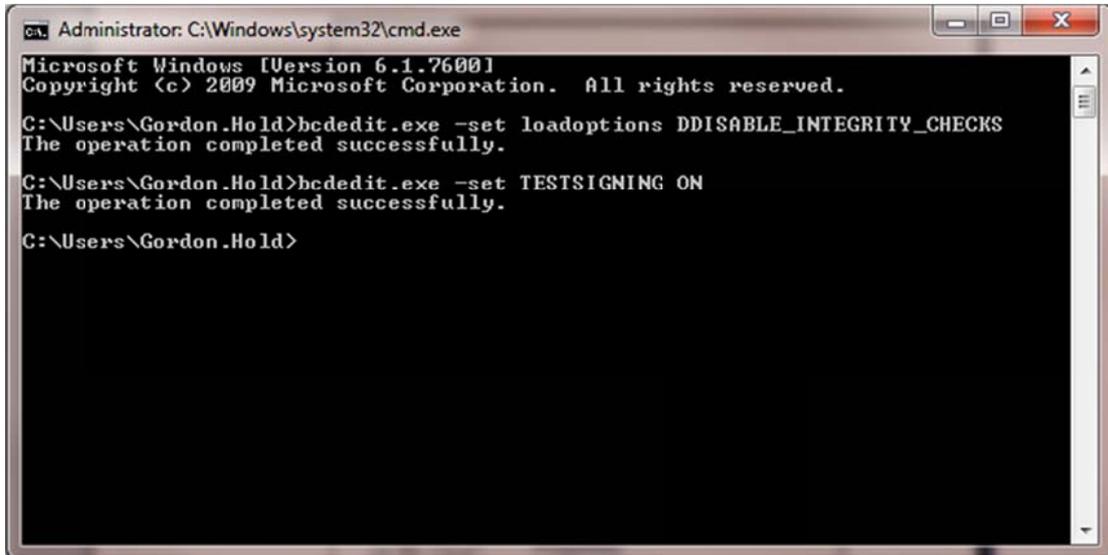
Restart the PC. When logged, the following will be displayed in the bottom right corner of the desktop:
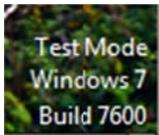
Microsoft® SQL Server 2005 Express Edition SP2 is installed first, if not already installed, followed by Sontay® SonNet CMS and finally the Sontay® device USB device drivers.

Note that there is an issue with SQL Server 2005 Express Edition SP2 and MSXML 6 SP2 (see Microsoft Knowledge Base article KB954459 for full details). To overcome this, the CMS installation will offer to run the Windows Installer Cleanup Utility to uninstall MSXML6 SP2. When this message appears, click on the <Install> button.

Installing the CMS
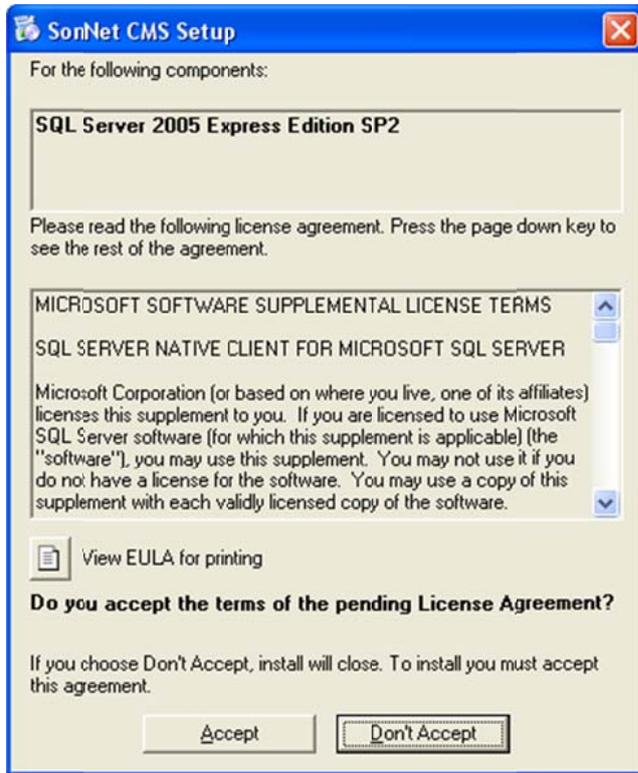
NB It is important that the CMS installation be completed *prior* to connecting the PC to the receiver. Ensure that the PC on which you are installing the CMS is **NOT** connected to the receiver until the installation is complete.

The CMS is compatible with Microsoft® Windows XP SP2 or later, and Microsoft® Vista. The CMS installation CD comes with all required programme files and drivers, and includes Microsoft® SQL Server Express SP2.

NB You must be logged in to Windows with an administrator level user account to install the Sontay® CMS and Microsoft® SQL Server Express SP2.

If SQL Server 2005 Express Edition SP2 is not already installed on your PC, the following installation will be executed.

When the SQL Server 2005 Express Edition SP2 installation window appears, read the EULA and then click the <Accept> button.
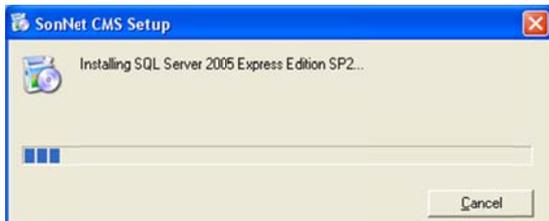
The installation of SQL Server 2005 Express Edition SP2 continues until complete.

The next step in the installation procedure will display the "Welcome to the SonNet CMS Setup Wizard. Click the <Next> button to continue.

Click <I Agree> and then the <Next> button to continue.
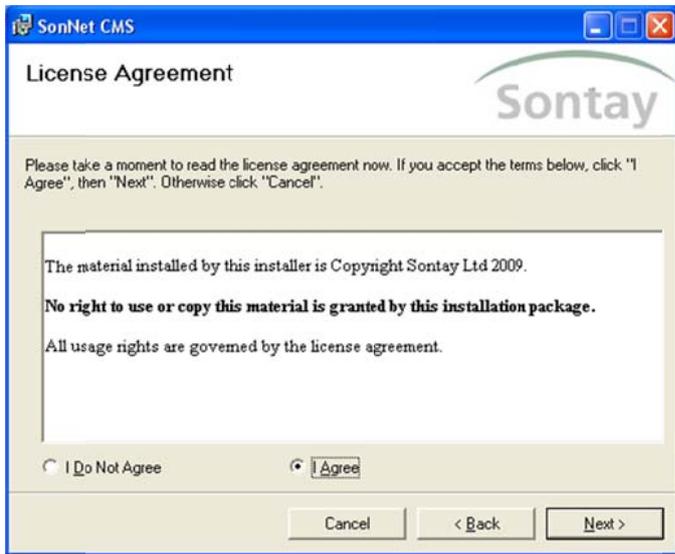
SonNet files are copied to your PC.
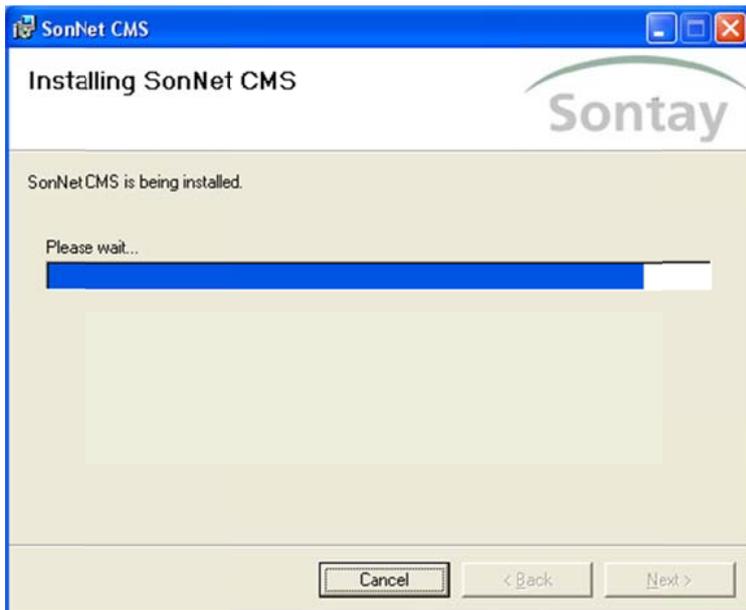
2 device drivers are required for the USB receiver connection.

To install these, click the <Next> button to continue.
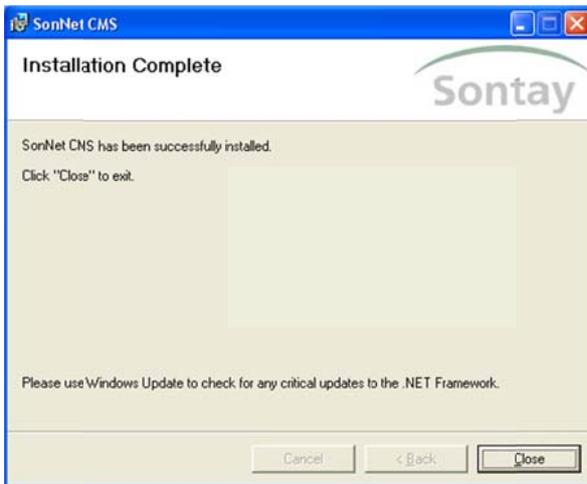
When the installation is complete, click the <Close> button.

Starting CMS

When the receiver is first connected to a USB port and switched on, the device manager will detect a new device. Follow these steps to install the drivers for the receiver.

Select the option shown ("No, not this time")

Select the option shown ("Install the software automatically")

When prompted, click the <Continue Anyway> button to continue.

There are 2 drivers to be installed, follow the same procedure for both drivers.

When the CMS is started, the PC com port connected to the receiver USB port needs to be defined.
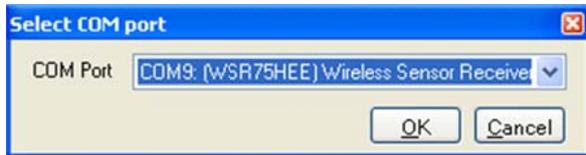
Importing a Saved Layout

When first run, the CMS may also ask if the user requires a saved XML layout file to be imported. This is useful if an existing layout has been saved on a site where the PC running CMS has been replace.
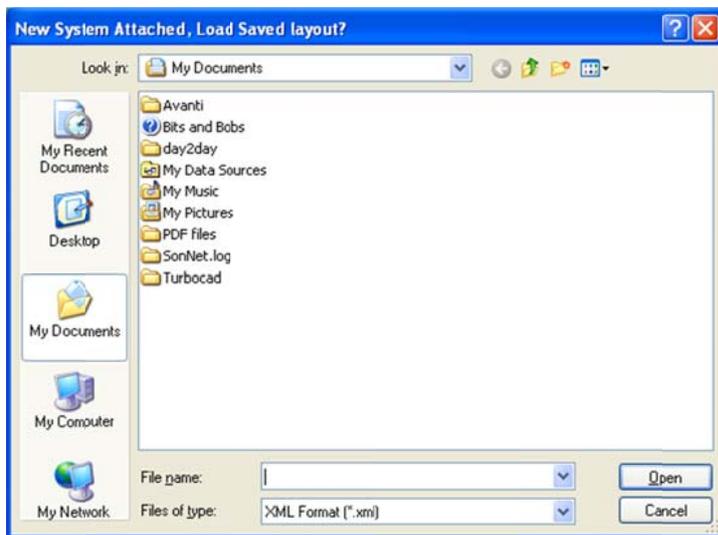
If no layout file is required, click the <Cancel> button to continue, otherwise navigate to the saved layout file to and click the <Open> button import it.

The CMS Desktop Environment

The CMS desktop is divided into 2 parts, a textual hierarchical display
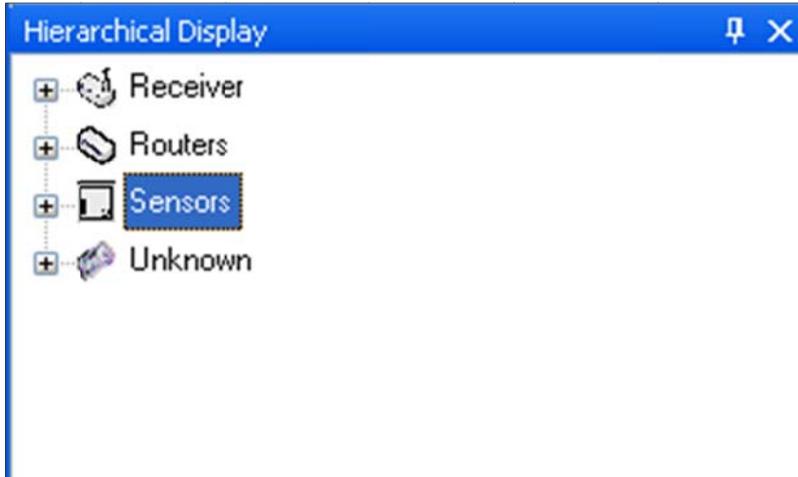
and a graphical "map" display.
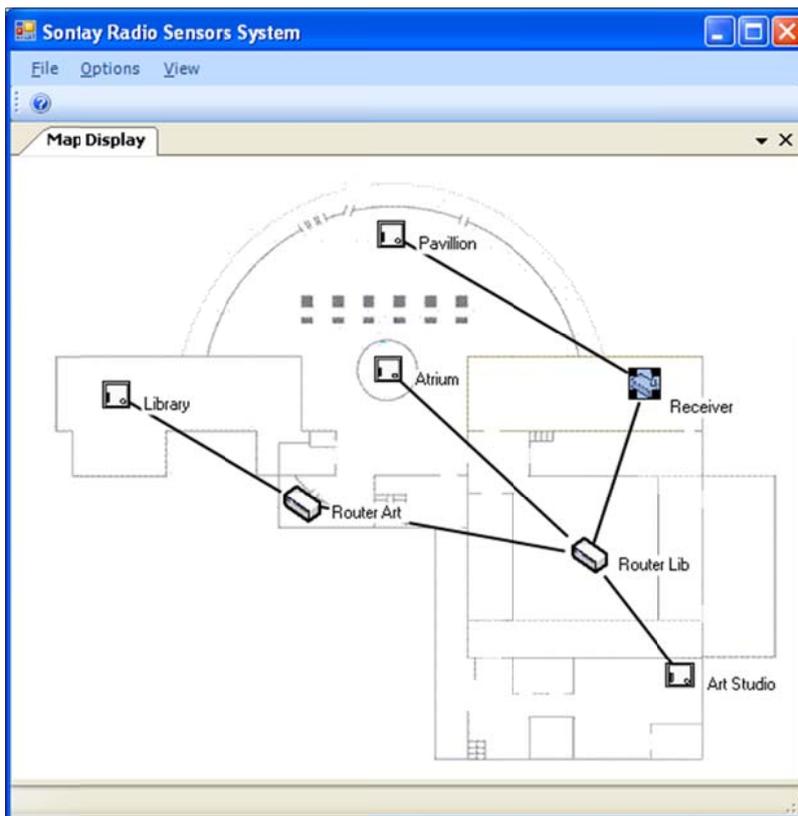
To enable the text display panel, from the menu bar choose <View> then <Textual Display>

To enable the graphical display panel, from the menu bar choose <View> then <Graphical Display>

Logging On as an Administrator

To make any changes to device configuration or to create or modify the graphical display, you must first log on as an administrator. To do this, from the menu bar choose <File> then <Switch Admin Mode>

The login box appears. Type in your admin level password. **NB** The default admin level password is *admin* (case sensitive). This can be changed once you have logged in.

Changing the Administrator Password

To change the admin password, from the menu bar choose <File> then <Change Password>. Enter the existing password, enter your new password and confirm. Click the <Update> button to submit the change, or click <Cancel>.

Auto Commissioning Mode

IMPORTANT!

When a new radio system network is being commissioned for the first time, it is **_essential_** to place the receiver in automatic commissioning mode for the network to form.

If this is not done, the network is treated as secure, and will not allow any nodes or routers to join the network without manually authorising each device (this involves entering the device MAC address).

To place the receiver and network in automatic commissioning mode, ensure you are logged on as an administrator.

From the menu bar, select <Options> and click <Auto-commissioning Mode>. A tick beside this option denotes that this special mode is enabled
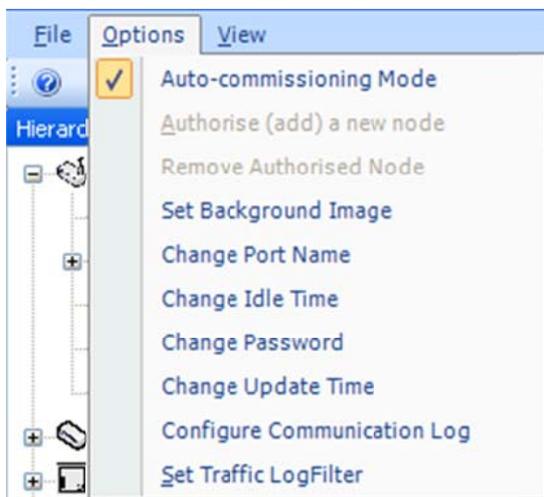
The status bar of CMS displays whether the receiver is in auto-commissioning mode or if the network is locked.

     Network Locked

     Auto-commissioning mode

When the network has formed completely, and all devices can be viewed in the CMS, it is **strongly recommended that the receiver and network be taken out of auto-commissioning mode**.

To take the receiver and network out of automatic commissioning mode, ensure you are logged on as an administrator.

From the menu bar, select <Options> and click <Auto-commissioning Mode>. There should not be a tick beside this option, and denotes that this special mode is disabled.

This secures the network and ensures that unauthorised nodes cannot join the network.

To prevent leaving the CMS in an admin state when not supervised, the admin log-in status automatically times out after the time set in the "Change Idle Time" setting expires. To disable this feature (**not recommended**), or to change the timeout value, from the menu bar choose <Options> then <Change Idle Time>

Removing the tick the Enable Idle Time Out box disables admin timeout feature. The timeout value can also be changed.

List Devices

In the text display panel on the left of the window, a list of all devices on the network can be found. These devices are divided into 3 main categories, receiver, routers and battery powered sensor nodes.
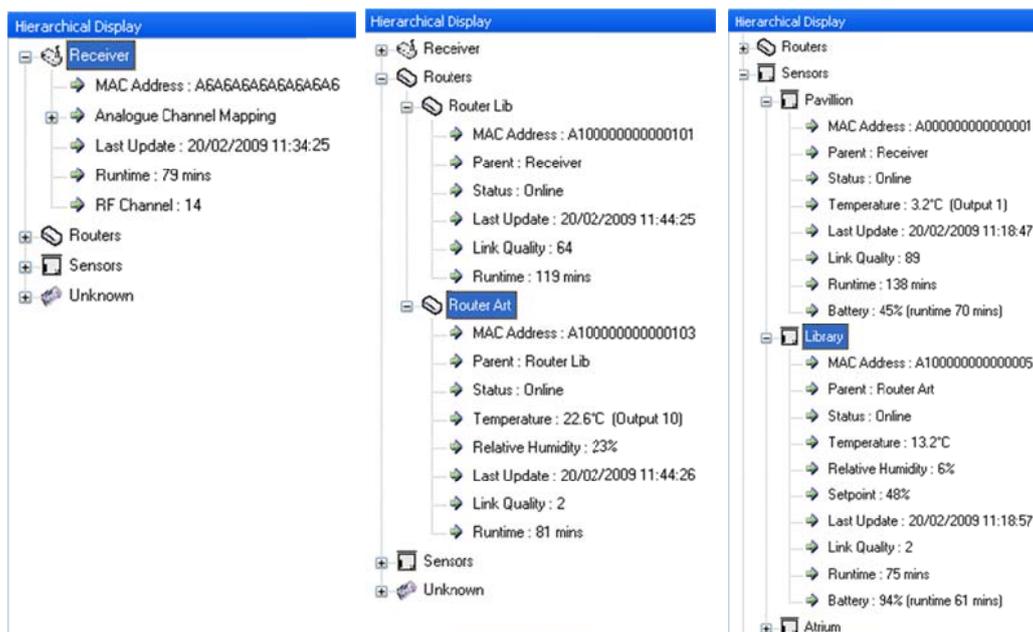
Each category can be expanded to view more detail or collapsed to hide detail.

The "Unknown" category is initially populated by devices which are joining the network for the first time, either by auto-commissioning or manual authorization. Devices are held in the unknown category until CMS has determined the type of device trying to join (for example, a router or node) and which options, if any, are fitted (such as setpoint). When CMS has determined this information, the device will then automatically be placed in it's appropriate category.

Changing Device Labels

Each device, when first depicted in the CMS, has a default label, such as "Router1" or "Sensor2". To give the router a more meaningful label, right click on the router and choose <Properties>
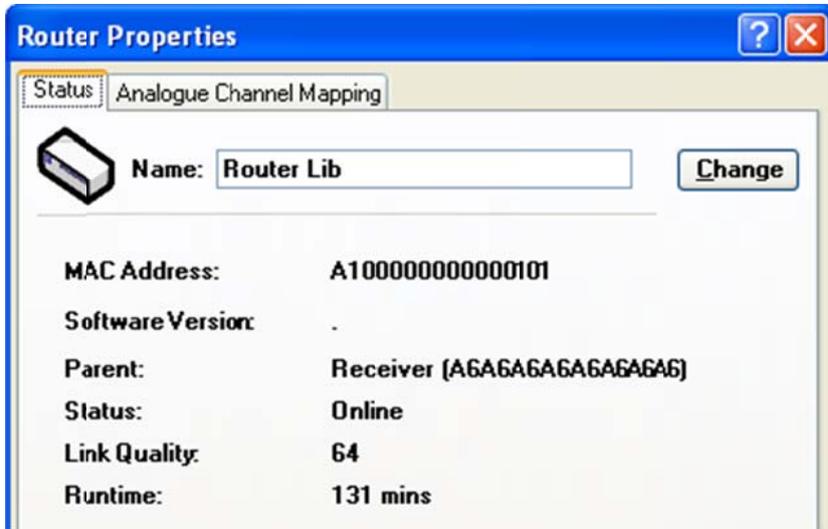
In the <Name> box, type in the new name you require and click the <Change> button.

NB There is a limit of 10 ASCII characters for router names.

To give a sensor a more meaningful label, right click on the sensor and choose <Properties>

In the <Name> box, type in the new name you require and click the <Change> button.

NB There is a limit of 10 ASCII characters for sensor names.
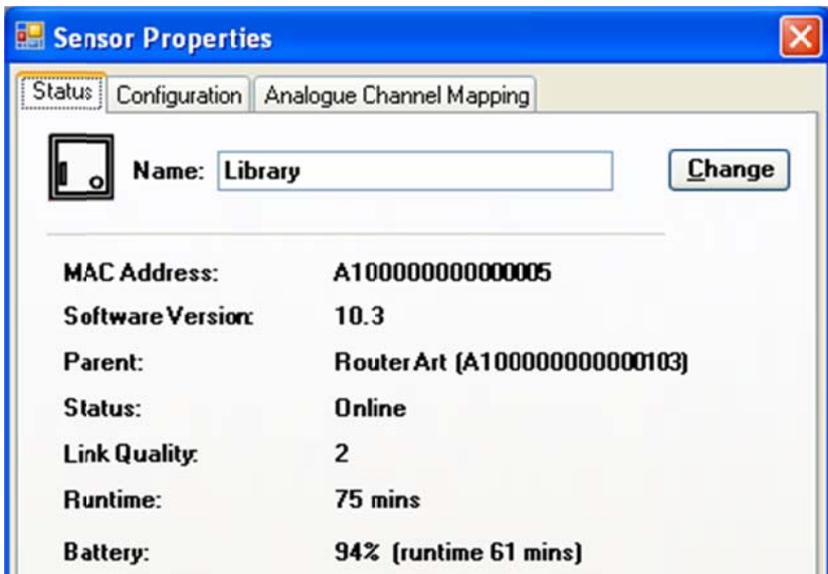
Creating Analogue Output Channel Mapping

Each sensor has at least one measured value, and with options fitted can have up to 4 measured values. These values need to be "mapped" or assigned to a unique 0-10Vdc output channels on the receiver.

Parameters which can be mapped to an output channel are:

- Temperature
- Relative Humidity
- Setpoint level
- Momentary switch status

To map these parameters, first select the sensor (or router with sensing element).
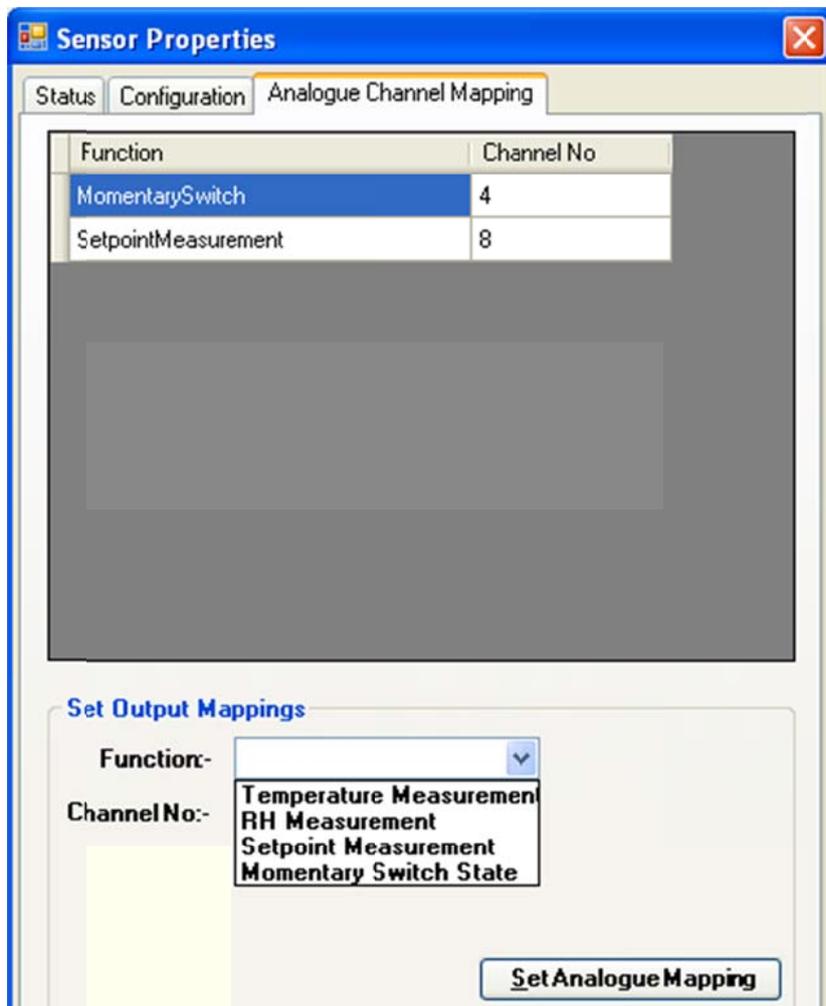
Right-click on the device, and select <Properties> from the drop-down menu.

Select the <Analogue Channel Mapping> tab.

Using the <Function> list box, select which device parameter to map.

Using the <Channel No.> list box, select the output channel to map to.

Click the <Set Analogue Mapping> button to accept the changes, or the <Close> button to exit with accepting the mapping changes.

Repeat this operation for all device parameters, and for all devices.

To remove an analogue channel mapping, follow the steps above, but select <No Mapping> from the <Channel No.> list box.

Viewing Device Properties
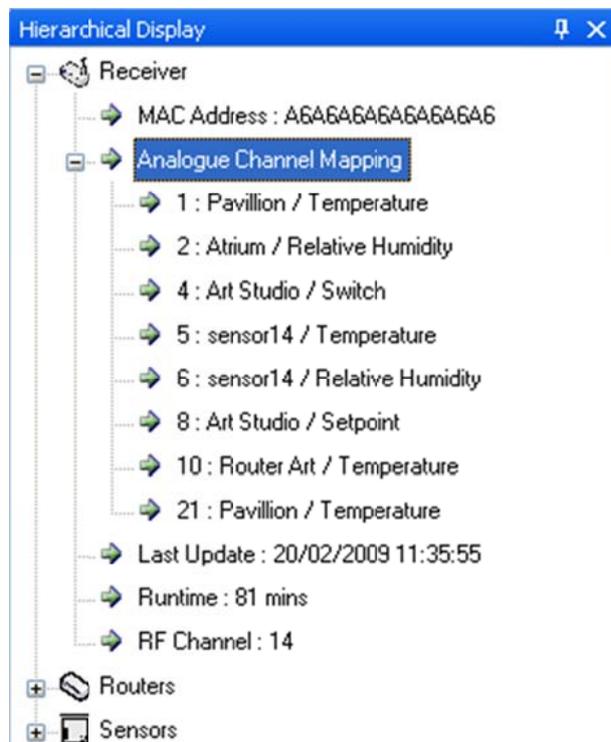
To view the current analogue output channel mappings, expand the receiver in the text display.
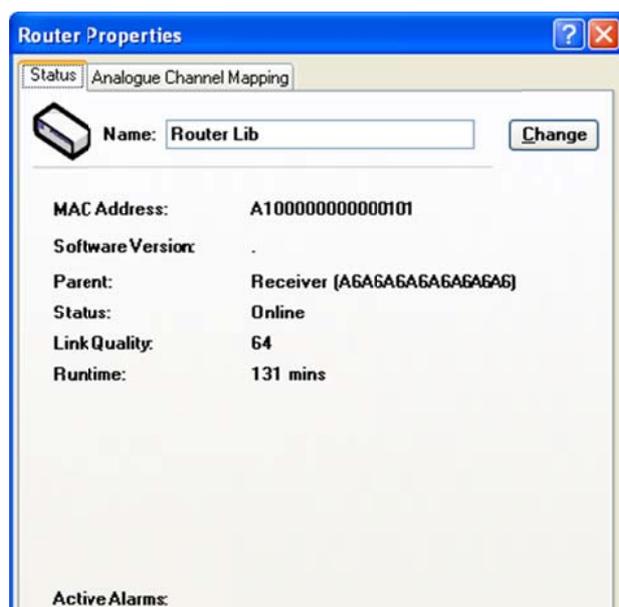
The specific properties of any device can be viewed by right-clicking a device and selecting <Properties> in the drop-down menu.

Available router properties are:

Parent (if applicable)
MAC address
Software version
Status
Link Quality
Runtime
Any active alarms

Available sensor properties are:

Parent (if applicable)
MAC address
Software version
Status
Link Quality
Runtime
Battery level
Any measured values
Any active alarms

Available receiver properties are:

MAC address
Software version
RF channel used
Runtime
Authorised nodes

Changing Device Configurations

Battery powered nodes have configurable parameters. The setting of these can be important for battery powered devices, as these will affect battery life. For example, if a temperature sensor in a room is set up to transmit it's value every 10 seconds, the battery life will be less than if the sensor were set to transmit values every 5 minutes.

Consideration should be given to each device and how often it should send values and still maintain the required level of control to maximise battery life. However, setting a transmission interval to a high level may result in having to wait for the set interval time to elapse before current data is shown when re-connecting the CMS to a receiver.

Temperature in a room doesn't normally change by a significant amount in a few minutes, RH even less so.

Setpoint values are only sent if the value changes by a configurable level. The same is true for the momentary switch, data is only transmitted on a change of status (ON or OFF).

Temperature and RH can also be configured to send on a "significant change of value". These values are also configurable by the administrator.

Configurable Parameters

To view or change battery powered sensor node parameters, right-click on the required device and select <Properties> from the drop-down menu. Select the <Configuration> tab.

Measurement interval
Temperature change threshold
RH change threshold
Setpoint threshold

When all changes are complete, click the <Change> button to accept the changes, or the <Close> button to exit without accepting the changes.

Authorising a new node

When adding an additional node to an existing system, **it is strongly recommended that the auto-commissioning method is not used** unless the number of new nodes to be added becomes time-prohibitive.
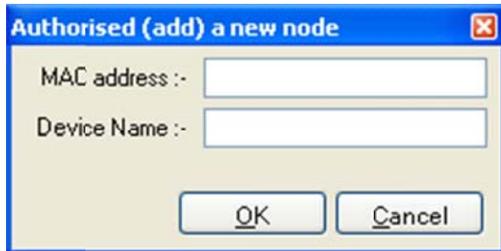
To manually authorise a new node(s), you must be logged on at administrator level. From the menu bar, click on <Options> and then select <Authorise (add) a new node> from the drop-down menu.

You will need to make a note of the unique 16-digit MAC address of the new node, found on the label on the device. Ensure the new device is powered on.
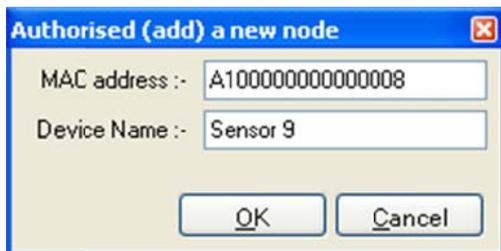
Enter this MAC address and a device label into the appropriate box fields and click <OK> to submit the details, or click <Cancel> to discard the information.

Removing a node from the network
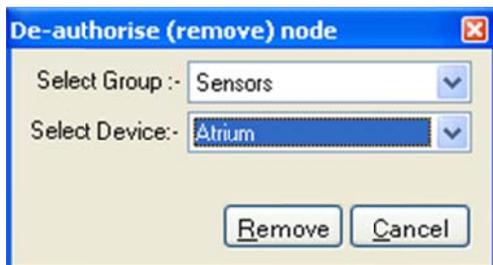
To remove a node from the network, from the menu bar, click on <Options> and then select <De-authorise (remove) node> from the drop-down menu. Select the device group (routers or sensors) and then select the device by name (label).

Click <Remove> to submit the details, or click <Cancel> to discard the action.

Using the Graphical Map Display

Apart from the text hierarchical display, the CMS offers a graphical environment which allows users to quickly determine how the network is functioning.

By default, there is no graphic image set as a backdrop for the map display.

A typical image to use for the map display would be a floor plan of the environment in which the radio network has been installed.

Setting The Map Display Background Image

To set a background image for the map display, you must be logged on at administrator level.
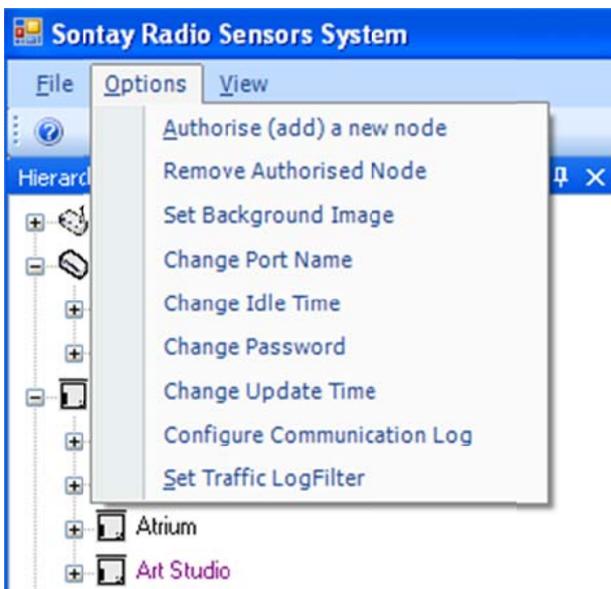
From the menu bar, click on <Options> and then select <Set Background Image> from the drop-down menu.
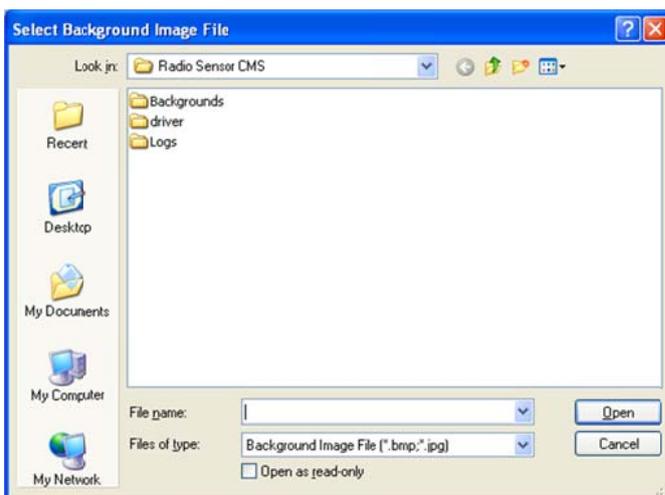
Browse to the image file required. Image file formats currently supported are:

Bitmap (.bmp)
JPEG (.jpg)

Adding Devices To The Map Display

To add a device to the map display, simply "drag-and-drop" a device from the text hierarchical display onto the graphic background.

Add the receiver to the graphic first, then routers followed by battery powered nodes. Links are automatically generated, showing the true network architecture.

Different icons are used to depict the receiver, routers and battery powered node, making identification easy. The icons also depict the status of the device, and change to reflect whether a device is OK, off-line, or in alarm.

Icon Plan

A schedule of what each icon and icon colour can be quickly found from the menu bar, click on <Help> and then select <Icons> from the drop-down menu.

The following pop-up window is displayed:
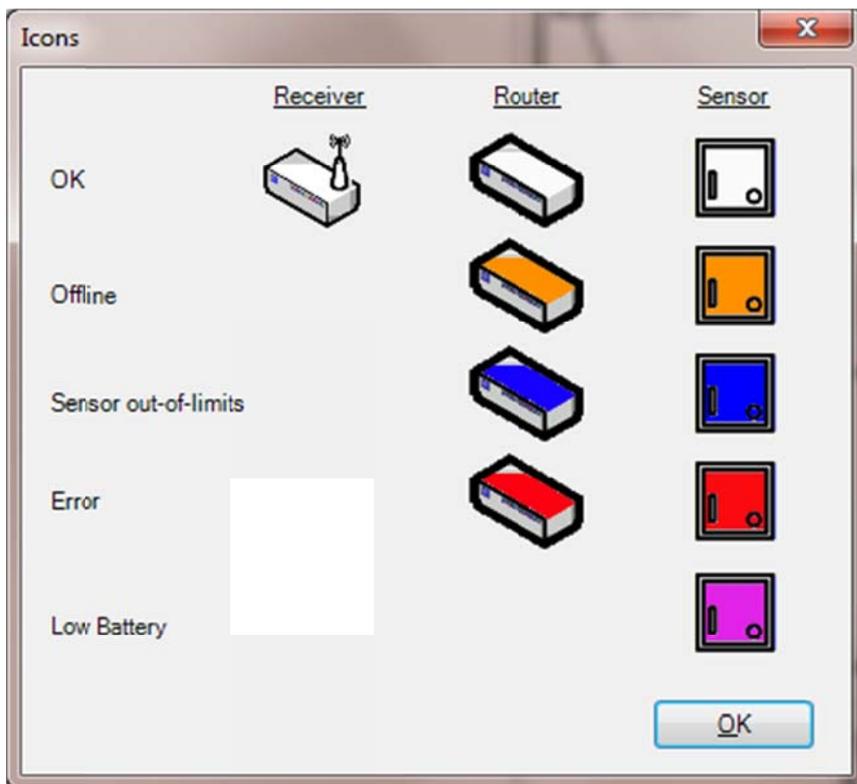
Device Status

A quick check on a device status can be made by hovering the mouse cursor over a device on the map display.
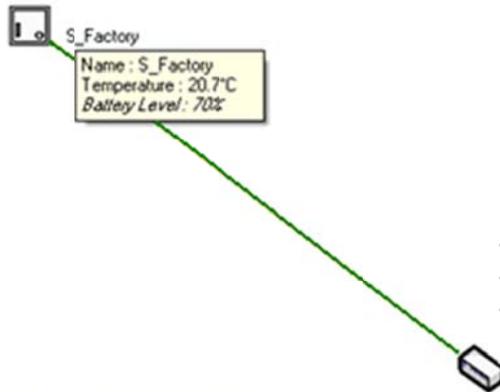
Displayed parameters are device dependent, but include:

- Device name (label)
- All sensor values
- Battery level (battery devices only)

NB Where link quality, hours run and battery level are shown in *italics*, this denotes that a request for data has been sent to a device, but the device has not yet responded.

Link Status

The link status is represented graphically by the colour of the link drawn.
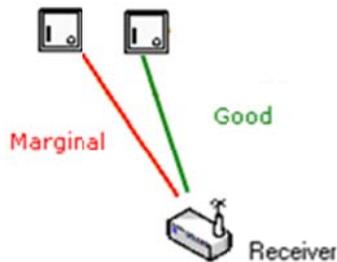
Green: Indicates good link quality.

Red: Indicates marginal link quality.
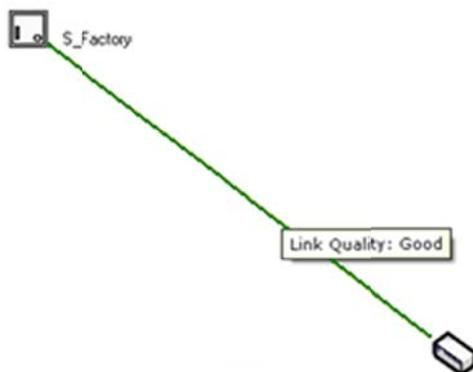
A quick check on any link status can be made by hovering the mouse cursor over a link on the map display.

Auto Updating

The CMS can be configured to update at a user configurable rate.

From the menu bar, click on <Options> and then select <Change Update Time> from the drop-down menu. Adjust the update time accordingly. Click <OK> to submit the change, or click <Cancel> to discard the change.

Auto updating can also be disabled.

From the menu bar, click on <Options> and then select <Change Update Time> from the drop-down menu. Remove the tick from the <Auto Update> box. Click <OK> to submit the change, or click <Cancel> to discard the change.

Manual Refreshing Of Data

Node or network data can be manually refreshed. **This is an important feature when re-connecting the CMS to an existing network**.
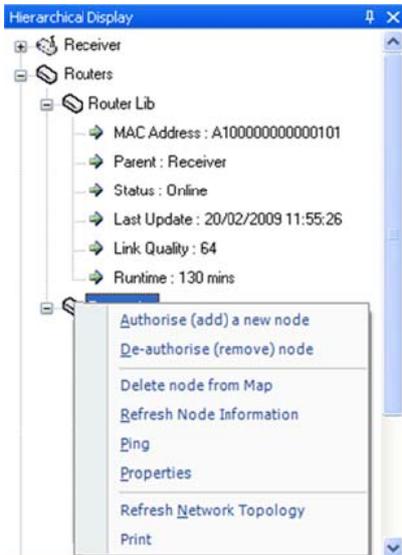
When re-connecting the CMS to a receiver on an existing network, data will only be refreshed to the CMS as and when a device updates it's information by timed transmission.

To ensure all data is sent as soon as possible, use the Refresh Node Information or Refresh Network Information options.

To manually refresh node data, right click on a node and then select <Refresh Node Information> from the drop-down menu.

To manually refresh network data, right click on a blank space (on the text or graphical display) and then select <Refresh Network Information> from the drop-down menu.

Communications Log

The CMS can keep a log of all communications on the network. This can be helpful in finding faults or diagnosing network problems.

By default, the communications log is enabled. If you want to disable this feature,

Configure Communication Log

☐ Enable Communication Log

OK   Cancel

From the menu bar, click on <Options> and then select <Configure Communication Log> from the drop-down menu. Remove the tick from the <Enable Communication Log> box. Click <OK> to submit the change, or click <Cancel> to discard the change.

To view the communications log, from the menu bar choose <View> then <Communications Log>. A window will appear at the bottom of the main CMS window. To close this view, click the cross in the top right of the communications log window.

Communications Log

```
Receiver : Pending:  Address: A100000000000005 Function: ChildLQI
Receiver :  RawPacket -0x00 0xA4 0x40 0xA1 0x00 0x00 0x00 0x00 0x00 0x00 0x02 0x81 0x7E
Receiver : Pending:  Address: A100000000000002 Function: ChildLQI
Receiver :  RawPacket -0x00 0xA5 0x40 0xA1 0x00 0x00 0x00 0x00 0x00 0x00 0x03 0x81 0x81
Receiver : Pending:  Address: A100000000000003 Function: ChildLQI
Receiver :  RawPacket -0x84 0x70 0x60 0xA1 0x00 0x00 0x00 0x00 0x00 0x01 0x03 0x00 0xBC 0xC2 0x06
Receiver : Complete :  Address: A100000000000103
 Compound Responses : ParentLQI, Router = true
Receiver :  RawPacket -0x84 0x60 0xA1 0x00 0x00 0x00 0x00 0x00 0x01 0x03 0x00 0x1A 0x1A 0x03
Receiver : Pending:  Address: A100000000000103 Function: ChildLQI
Receiver :  RawPacket -0x81 0x7E 0x60 0xA1 0x00 0x00 0x00 0x00 0x00 0x00 0x05 0x00 0x1A 0x1A 0x64
Receiver : Pending:  Address: A100000000000005 Function: ChildLQI
Receiver :  RawPacket -0x81 0x7E 0x60 0xA1 0x00 0x00 0x00 0x00 0x00 0x00 0x02 0x00 0x1A 0x1A 0x64
Receiver : Pending:  Address: A100000000000002 Function: ChildLQI
Receiver :  RawPacket -0x81 0x81 0x60 0xA1 0x00 0x00 0x00 0x00 0x00 0x00 0x03 0x00 0x1A 0x1A 0xFF
Receiver : Pending:  Address: A100000000000003 Function: ChildLQI
Receiver :  RawPacket - - Event :0x00 0x0A 0x81 0xA0 0x00 0x00 0x00 0x00 0x00 0x00 0x01 0x0C 0xB0 0x84
Receiver :  -Event :Complete:  Address: A000000000000001 Function: MeasurementData
```

Configuration Log

The configuration log allows the user to view a concise list of any changes made to the configuration of devices. To view the communications log, from the menu bar choose <View> then <Configuration Log>.

Results shown can be filtered to show only specific "key fields" such as when a configuration was changed, or analogue output mappings.

Results can also be filtered within a user-definable date range.

Using CMS To Document A Wireless Network

Saving and Opening Layouts

When a network is commissioned, it is very useful to save the graphical map layout to use as a reference and as the basis for comparison when checking the current status of network topology.

Saving a layout records the backdrop (if used) and the position and size of each device icon on the map display.

To save a layout, click on <File> then <Save Layout>
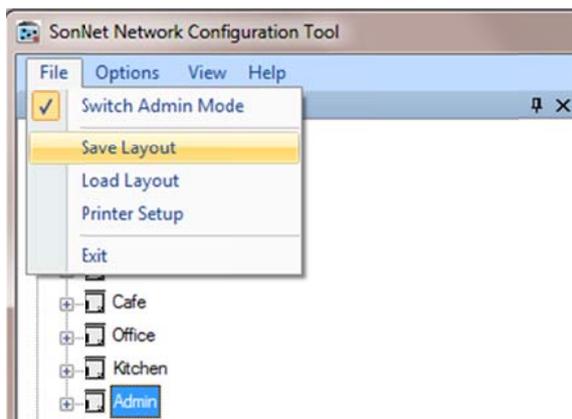
To open a saved layout, click on <File> then <Load Layout>
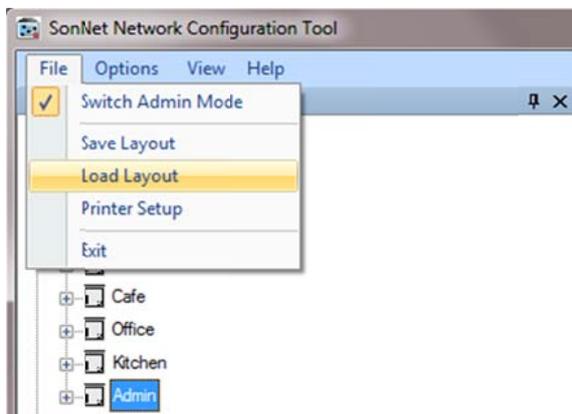
A library of site layouts can be formed as a reference.

Receiver Print Preview

To generate a comprehensive text document of network devices, from the hierarchical display, right-click on the receiver object, and from the menu select <Print Preview>.
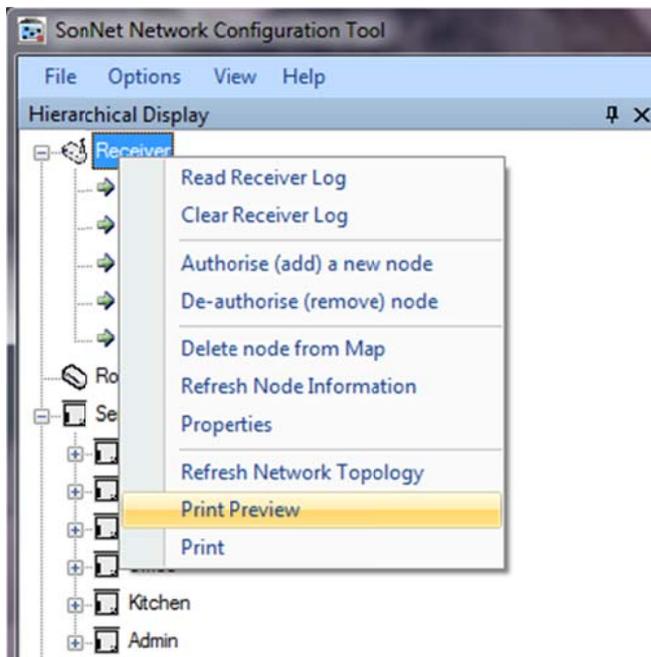
A document is automatically generated, which can be printed on paper for an O&M manual, or to .PDF file, for example.
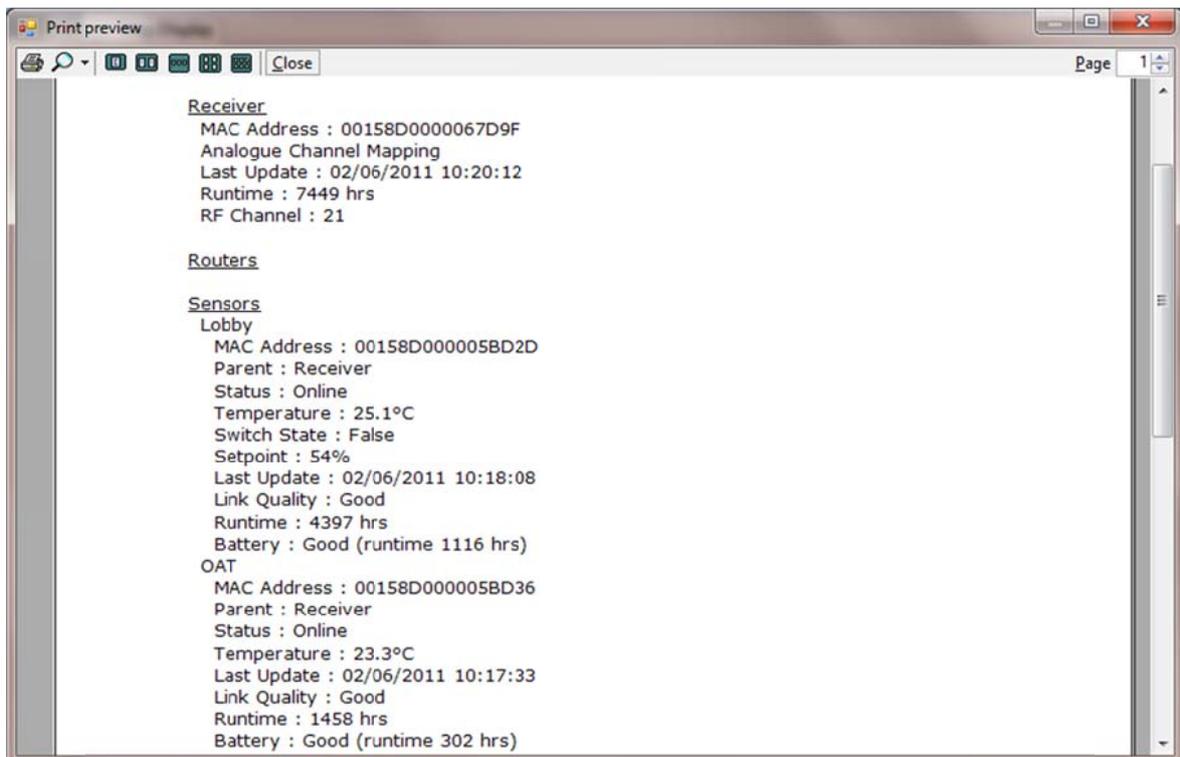
Commissioning A SonNet System: A Step-By-Step Guide

1. Mount the receiver using the DIN carrier clip. **NB** - it is extremely important that if the receiver is to be mounted in an enclosed panel (metal or plastic) that an external aerial extension is used. Two are available from Sontay, a 2 metre version **RF-AERIAL-PM2** and a 5 metre version **RF-AERIAL-PM5**. If the aerial is to be mounted on top of the receiver panel, the extension bulk head jack should be mounted through a hole (preferably on the top of the panel) and secured in place with the star washer and hex nut. If the aerial is to be mounted remotely, the extension lead should be passed through a protective cable gland on the panel. The connector on the other end of the extension should be screwed hand tight onto the aerial connector located on the receiver PCB. Do NOT over tighten.
2. Fit the receiver aerial to the receiver PCB mounted connector, or if using an aerial extension, to the bulk head jack connector.
3. Ensure, where possible, that the receiver aerial is aligned vertically, and as far away from obstructions as possible.
4. Ensure that the receiver power supply polarity is correct if using a 24Vdc supply.
5. Mount all routers in their appropriate positions, as determined by the site survey. Ensure that the power supply polarity is correct if using a 24Vdc supply.
6. Ensure, where possible, that the router aerials are aligned vertically, and as far away from obstructions as possible.
7. Do NOT switch on the router(s) until all SonNet devices are installed and ready for commissioning.
8. Mount all end devices (EDs) in their appropriate positions.
   a. Ensure that each space housing ED is mounted with the tamperproof screw at the bottom. This ensures the integral PCB aerial is in the correct alignment.
   b. Ensure that each plant housing ED is mounted with the aerials aligned vertically, and as far away from obstructions as possible.
9. Do NOT switch on EDs until the receiver and ALL routers are installed and commissioned.
10. Connect the receiver's USB connector to a laptop or PC with CMS installed.
11. Switch on the receiver. If this is the first time the receiver has been commissioned, note that the red LED near the reset button is flashing. This indicates that the receiver has no child devices on the network.
12. If required, install the 2 drivers required for CMS (see page 23). Windows 7 users, please see page 18
13. Start CMS by double-clicking the desktop icon. Select the required com port (see page 24). Log on at admin level (see page 26 and 28).
14. If required, add a background image to CMS map display (see page 35).
15. Using CMS, ensure that the receiver appears in the hierarchical display. Add to the map display by drag-and-drop.
16. Place the receiver in auto-commissioning mode (see page 27).
17. Referencing the site survey plans, switch on all the routers using the PCB jumper, starting with those closest to the receiver (i.e. "layer 1"). Carry on with the next layers of routers until all routers are switched on.
18. Using CMS, ensure that all the routers appear in the hierarchical display.
   a. Note that initially, the routers will be shown in the "Unknown" category in the hierarchical display. This is normal.
   b. Ensure that each router moves to the "Router" category in the hierarchical display. Depending on the number of devices on the network, this may take a couple of minutes.
19. Add all routers to the map display by drag-and-drop. Note that if a device is shown in blue in the hierarchical display, it has NOT been added to the map display. This is a quick way to see which have yet to be added to the map display. Ensure all are shown as on-line. Note that the radio network links are displayed on the map display. Ensure all links are depicted in green (good link quality) and note the LQIs (see page 37).

a. If any routers don't show as on-line or are not in the "Router" category in the hierarchical display, check that the PCB fuse is intact (0Ω on a multimeter) and that the correct power supply is present.

b. If any router's link is shown in red, check for obstructions between it and it's parent, check to see that the aerial is fitted and is vertical.

20. Referencing the site survey plans, switch on all the EDs by fitting the power jumper and remount into the housing (for space housing devices).

a. If this is the first time the ED has been switched on (or after replacing an EDs battery), hold down the reset button on the ED's PCB while powering up by fitting the power jumper. This resets the battery hours run to 0.

21. Using CMS, ensure that all the EDs appear in the hierarchical display.

a. Note that initially, the EDs will be shown in the "Unknown" category in the hierarchical display. This is normal.

b. Ensure that each ED moves to the "Sensor" category in the hierarchical display. Depending on the number of devices on the network, this may take several minutes.

22. When all EDs have joined the network, use CMS to disable auto-commissioning mode. **NB** - this is important, as trying to change configuration properties while in auto-commissioning mode may cause network errors.

23. Add all EDs to the map display by drag-and-drop. Note that if a device is shown in blue in the hierarchical display, it has NOT been added to the map display. This is a quick way to see which have yet to be added to the map display. Ensure all are shown as on-line. Note that the radio network links are displayed on the map display. Ensure all links are depicted in green and note the LQIs.

a. If any EDs don't show as on-line or are not in the "Sensor" category in the hierarchical display, check that the correct battery is fitted, observing polarity.

b. If any EDs link is shown in red, check for obstructions between it and it's parent, check to see that the aerial is fitted and is vertical (for plant housing EDs) or that the housing is mounted correctly (for space housing EDs).

24. In the hierarchical display, right-click on each ED and select "Refresh Node Information" from the menu. This will cause the ED to transmit not only it's measurements, but also it's hours run and battery hours run data as well. **NB** - This extra data is NOT normally transmitted, but must be requested using CMS. Where hours run and battery level are shown in *italics*, this denotes that a request for data has been sent to a device, but the device has not yet responded.

25. When the installed network is finally formed, briefly press the receiver reset button and ensure the network reforms properly. This may take several minutes, depending on the number of network devices.

26. When the network topology has been verified and all devices are working correctly, user configuration can begin (see pages 29 - 33).

27. Map all receiver analogue outputs needed to the required device measurements (see page 30).

28. When configuration is complete, save the map display layout (see page 41).

29. Generate a report of the completed network to document it for future reference (see page 42).

Best Practise Points:

1. Always conduct a site survey, and ensure that if you plan to use an external extension aerial on the system receiver (for example, if the receiver is to be in a metal panel), you use the same external extension aerial on the SSK receiver for the survey. Document the survey thoroughly, and leave a copy on site.

2. When planning where routers are going to be needed, plan for "redundancy", i.e. what happens to all the EDs connected to a router if the router fails? Backup routers are worth considering. See pages 11 - 13.

3. Don't switch on EDs until they're ready to be commissioned. If they're powered on without a parent in range, they will eventually sleep to preserve battery life, only "waking" occasionally to scan for a parent. This may slow commissioning down. If an ED has been powered up for more than 20 minutes without a parent, power-cycle it. ***Pressing the reset button on an ED DOESN'T reset the ED, it only resets the battery hours run time***.

4. Generally speaking, wireless works best in a horizontal plane, so expect reduced signal strength if he receiver is on a different floor to the routers/EDs. A good rule of thumb is have the receiver on the same floor as it's children, though this isn't always the case.

5. 2.4GHz wireless signals don't go through metal! Plan to circumvent metal obstructions where possible.

6. If the installation environment is one where obstructions are likely to change regularly (in a warehouse, for example!), try to conduct the site survey under a "worst-case" scenario - i.e. assume that at some point, there's going to be an obstruction between the ED/router and it's parent at some time. Simulate it, if possible.

7. When commissioning the installed system, turn the receiver on first, then all the routers - starting with "layer" nearest the receiver and working outwards. It's worthwhile checking all the routers are OK in CMS **before** finally powering up the EDs.

8. When EDs first join a network, values such as hours run and battery hours run will not be displayed - the values are shown as question marks. This is normal, these values need to be requested from the device (right-click on device and select "Refresh Node Information").

9. Remember that when a receiver scans all 16 channels for the best one, the channel chosen is the best *where the receiver is*. On "long" networks with several "layers" of routers, the channel chosen by the receiver may not always be the quietest at the far end of the network. When the installed network is finally formed, press the receiver reset button and ensure the network reforms properly. This will ensure that, in the event that the receiver needs to change channels (for example), it will work seamlessly.

10. As each network is commissioned, save the layout - even if there isn't a background graphic loaded. This is a good aid to quickly viewing network topology.

11. Document each network! In CMS, right-click on the receiver in the hierarchical display and select "Print Preview" from the menu and print (to paper or a file, such as .PDF) the preview document. This gives a reference to call on at a later date if required.